

REMARKS

The outstanding Office Action mailed July 8, 2003 (Paper No. 14) has been carefully considered. In response thereto, please enter the following amendments in which claims 36, 43 and 44 are amended, and claims 45-53 are added. Dependent claim 43 was amended to change its dependency. Claims 36, 39, 40, and 43-53 are now pending in the present application. Reconsideration and allowance of the application and presently pending claims, as amended, are respectfully requested.

Response to 35 U.S.C. §112, First Paragraph Rejection

Claims 36, 29, 40, 43, and 44 stand rejected under 35 U.S.C. §112, first paragraph, as allegedly failing to comply with the written description requirement. Specifically, claim 36 included the limitation of a “*pulse waveform power source* adapted to cycle between a positive electrical potential and a negative electrical potential, wherein the negative potential is below the first electrical potential, and wherein the positive potential is such that electrons having kinetic energy less than 100 electron-volts are attracted to the substrate and etch material therefrom”, which the USPTO regarded as not being described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. Applicants traverse the rejection for at least the following reasons.

With regards to the limitation of “a pulse waveform power source adapted to cycle between a positive electrical potential and a negative electrical potential”, those skilled in the art would recognize that the AC power source (19) is adapted to cycle between positive and negative potentials and that an AC power source is not limited to continuous wave power sources such as a sine wave form but also include pulse wave forms such as, but not limited to, square waves. Furthermore, the specification recites at page 16, lines 3 – 17:

... sample 16 must be **periodically** “discharged” or “neutralized” by reducing the external bias supplied through mechanical support 12 slightly *below* plasma potential. This will enable a sufficient number of positive ions 34 to arrive from the plasma to cancel the accumulated negative charge, while keeping their energy too small to inflict ion bombardment damage. Thus, **the substrate sample 16 on mechanical support 12 must be subjected to a modulated positive voltage supplied on connection**

18 to mechanical support 12. When this external bias is “high,” LE4 occurs. When this external bias is “low,” the negative charge on the substrate is being neutralized. **The magnitude of the positive bias must be sufficient to reject positive ions 34 and also large enough to give electrons 37 sufficient energy to overcome the threshold for LE4.** The frequency of bias pulse must be sufficient to prevent negative charge buildup (which would stop LE4) by discharging sample 16 often enough. **The requisite *magnitude and frequency*, as well as the *optimal waveform* (e.g. square wave vs. sinusoidal) must be determined empirically for each combination of substrate and etching gas.**

(Emphasis Added.)

Thus, Applicants respectfully submit that the specification supports the limitation of a pulse wave form power source.

With regard to the limitation of “the positive potential is such that electrons having kinetic energy less than 100 electron-volts are attracted to the substrate and etch material therefrom”, the specification recites at page 7, lines 3 – 5:

the low energy electrons that are used in the present invention travel at less than about **100 electron volts** (eV) kinetic energy (KE), preferably at less than about 20 eV.

Thus, Applicants respectfully submit that the specification supports the limitation of etching with electrons having kinetic energy less than 100 electron volts.

Amendments to the Drawings

The drawings were objected to under 37 C.F.R. 1.83(a). Applicants have submitted herewith replacement sheets for Figure 1, 2, 3, and 4. The alternating current (AC) power sources 19, 21, and 71 have been amended to delete the continuous wave form symbol contained therein. As those skilled in the art recognize, alternating current (AC) wave forms include both continuous wave forms such as sine waves and pulse waves forms. Therefore, the amendments to FIG. 1 do not introduce new matter because pulse waves were inherently included in the output of the AC power sources.

Amendments to the Claims

Independent claim 36 was amended to further clarify the claimed invention. Specifically, independent claim 36 was amended to include the structural limitation of “a substrate etching means ... the substrate etching means comprises electrons ...,” which Applicants respectfully submit is a limitation not shown in the cited references.

Dependent claim 43 is amended to correct for antecedent basis, and dependent claim 44 was amended to further clarify the claimed invention.

Response to 35 U.S.C. §102 Rejection

Claims 36, 39, 40, 43, and 44 stand rejected under 35 U.S.C. §102(b) as allegedly being anticipated by Doki et al. (U.S. Patent No. 5,310,452). Applicant respectfully traverses this rejection on the grounds that the cited reference fails to disclose each claimed limitation.

Amended Claim 36 is as follows:

An apparatus for low-damage anisotropic electron dry etching of a substrate, comprising:

 a plasma reactor having a generally hollow interior adapted to substantially contain a plasma therein;

 a plasma creation means for generating a plasma, said plasma creation means at least partially disposed in said plasma chamber;

 a mechanical support within said plasma reactor adapted to receive said substrate, wherein said mechanical support is electrically isolated from said plasma creation means;

 a pulse waveform power source adapted to electrically bias said mechanical support and said substrate placed thereon; and

a substrate etching means for etching material from the substrate, wherein the substrate etching means comprises electrons from a plasma generated by the plasma creation means, wherein the electrons are attracted to the substrate by the pulse waveform power source biasing of the substrate holder and substrate.

(Emphasis Added.)

Applicants respectfully submit that the cited reference apparently is a conventional apparatus in which ions, not electrons, etch material. Applicants have claimed “a substrate etching means for etching material from the substrate, wherein the substrate etching means

comprises electrons from a plasma generated by the plasma creation means.” Because the cited reference employs ions to etch material, Applicants respectfully submit that the cited reference fails to disclose the limitation of “the substrate etching means comprises electrons from a plasma generated by the plasma creation means.” Therefore, Applicants respectfully request that this rejection be withdrawn.

Response to 35 U.S.C. §103 Rejection

Claims 36, 39, 40, 43, and 44 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Kaji et al (U.S. Patent No. 5, 290,993) in view of Doki et al. (U.S. Patent No. 5,310,452) and unpatentable over Okano et al (JP 56-81678-A) in view of Doki et al. (U.S. Patent No. 5,310,452). Applicant respectfully traverses these rejections on the grounds that the cited reference as a whole fail to disclose each claimed limitation.

Applicants respectfully submit that the cited references disclose ion etching and not electron etching. Therefore, Applicants respectfully submit that the cited references fail to disclose the claimed limitation of “a substrate etching means for etching material from the substrate, wherein the substrate etching means comprises electrons from a plasma generated by the plasma creation means.”

New Claims

Applicants have added dependent claim 45, which depends from claim 36, and claims 46 – 53. Independent claim 46 includes the limitation of “**an electron etcher means** for etching the substrate received by the substrate holder with electrons from the plasma ...”. Applicants respectfully submit that the cited references fail to disclose “an electron etcher means,” and therefore, Applicants respectfully submit that the new claim 46 and its dependents are allowable over the cited references.

CONCLUSION

In light of the foregoing amendments and for at least the reasons set forth above, Applicant respectfully submits that all objections and/or rejections have been traversed, rendered moot, and/or accommodated, and that the now pending claims 36, 39, 40, 43, and 44-53 are in condition for allowance. Favorable reconsideration and allowance of the present application and all pending claims are hereby courteously requested. If, in the opinion of the Examiner, a telephonic conference would expedite the examination of this matter, the Examiner is invited to call the undersigned agent at (770) 933-9500.

Respectfully submitted,

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